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Food of White Perch (*Morone americana*) and Potential for Competition with Yellow Perch (*Perca flavescens*) in Lake Erie[1]

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ABSTRACT. The white perch (*Morone americana*) is an east coast estuarine species that invaded Lake Erie in the 1950s, but did not increase in abundance until the mid 1970s. We studied the food of white perch in the Sandusky Bay area of western Lake Erie in 1981 and 1982 to assess potential for interactions with yellow perch. Based on volumetric displacement of individual food taxa, diets of white perch were similar to those of yellow perch, overlapping broadly in June and July 1981, when both species ate cladocerans and chironomids. Overlap declined in August 1981 when white perch began feeding on young-of-the-year gizzard shad, which were not generally eaten by yellow perch. Because food is limiting growth of yellow perch in western Lake Erie, if white perch continue to proliferate and share food with yellow perch, then competition could influence growth rates of yellow perch and thus could play an important role in attempting to manage the yellow perch fishery.

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INTRODUCTION

The Great Lakes fish community has a history of continual change in species abundance and composition (Berst and Spangler 1972, Christie 1972, Hartman 1972, Wells and McClain 1972). Overharvest and habitat alteration contributed to the observed changes (Regier and Hartman 1973, Christie 1974); however, catastrophic declines of native species have occurred only after certain marine fishes became established and proliferated throughout the upper Great Lakes (Aron and Smith 1971). Previous invasions of the sea lamprey (*Petromyzon marinus*), alewife (*Alosa pseudoharengus*), and rainbow smelt (*Osmerus mordax*) have invariably had a deleterious effect on the native fish community (Hartman 1972, Smith 1972, Christie 1972, 1974, Wells and McClain 1972). The mechanisms that underlie many of the observed changes are poorly understood (Crowder 1980).

White perch (*M. americana*) were first reported in Lake Erie in 1953 (Larsen 1954); they became firmly established by the mid 1970s (Busch et al. 1977, Bioleau 1985). Past experiences with marine invaders in the Great Lakes suggest that the establishment of this species in Lake Erie might adversely affect the resident fish community. The Ohio waters of Lake Erie support an extensive fishery for yellow perch (*Perca flavescens*) (Davies et al. 1983). Elrod et al. (1981) found considerable similarity in diets of sympatric yellow perch and white perch in eastern Lake Ontario. Thus, we believed that this species might be vulnerable to the white perch invasion. As of 1981, however, there was no information on the food of white perch in Lake Erie. The objectives of our study were to determine the food of white perch in the Sandusky Bay area of western Lake Erie, and to assess potential for interactions with yellow perch.

METHODS AND MATERIALS

Fish were collected at about 10-day intervals in the Sandusky Bay area of western Lake Erie (Fig. 1) in June-September 1981 and March-October 1982. Gill nets with panels 7.6 m long and graded meshes (1.9, 2.5, 3.2, 3.8, and 4.4 cm, square measure) were used most frequently. Semi-balloon bottom trawls (4.4-m headrope), trap nets, seines, and pulsed direct current electrofishing gear were also used where gill nets would have been ineffective or would have resulted in high mortality of other species. Short (generally 2-hour) sets of all passive gears were used to minimize digestion of food. Our samples were supplemented with white perch collected during bottom trawl surveys of the area conducted by the Ohio Department of Natural Resources, Division of Wildlife and the U.S. Fish and Wildlife Service.

Fish collected for food analyses were cut open ventrally upon capture and preserved immediately in 10% formalin. They were assigned an age on the basis of length. Food items were identified to order (invertebrates) or species (fish). Volumes of individual food

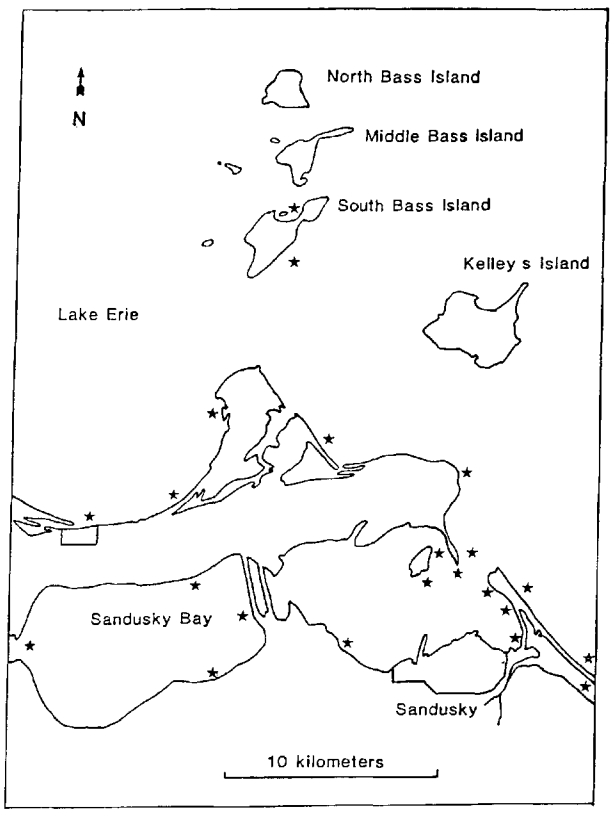

FIGURE 1. Primary sampling sites (stars) for white perch in Sandusky Bay and contiguous areas of western Lake Erie, 1981-1982.

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types were measured to the nearest 0.1 ml by water displacement in a graduated cylinder.

To analyze diet overlaps among white perch (75-175 mm total length) and yellow perch (50-200 mm total length) in 1981, we combined our white perch data with yellow perch data from Knight et al. (1984). Collection sites for the two species were located about 5-km apart, and thus, did not overlap spatially. However, they were similar habitats in terms of depth and substrate, and the two species were often collected together at each of the sites. The Schoener index was used to compare mean percent volumes, as suggested by Wallace (1981). An index value greater than 0.6 indicated significant diet overlap (Zaret and Rand 1971).

RESULTS AND DISCUSSION

Of the 1,562 white perch collected, 68% contained food. In 1981, yearling white perch generally ate cladocerans and chironomids until young-of-the-year gizzard shad *(Dorosoma cepedianum)* became available in August and September (Fig. 2A). Two-year-olds collected in 1981 ate gizzard shad (Fig. 2B). Yearling white perch were less piscivorous in 1982, a year of relatively low gizzard shad abundance (U.S. Fish and Wildlife Service, unpublished data), than in 1981 (Fig. 2C). Cladocerans and chironomids composed much of the volume of the diet. Two-year-old fish were piscivorous in spring and fall, but invertebrates remained important in the diet in summer (Fig. 2D). Fish eggs were a major constituent of the diet of white perch of both ages collected in July 1982 (Fig. 2C, D). Some of the eggs were from freshwater drum *(Aplodinotus grunniens),* but most were unidentifiable. We found no walleye *(Stizostedion vitreum vitreum),* yellow perch, or white bass *(M. chrysops)* in stomachs of white perch.

Diets of white perch were similar to those of yellow perch during part of 1981 (Table 1). Diets overlapped broadly in June and July, when both species ate cladocerans and chironomids. Overlap declined in August when white perch began feeding on young-of-the-year gizzard shad, which were not generally eaten by yellow perch.

Because walleyes and white bass in Lake Erie are generally piscivorous (Parsons 1971, Griswold and Tubb 1977, Knight et al. 1984), little resource overlap now exists between these species and white perch. However, older white perch, which were still uncommon during our study, are more piscivorous (Reid 1972, Warner 1974, Elrod et al. 1981). Considerable diet overlap indicated similarities in the diets of white perch and yellow perch in 1981. High diet overlaps are not proof of competition (Sale 1979, Schoener 1982), but these species have not co-evolved, and evolutionary mechanisms that would promote harmonious resource partitioning may not exist (Connell 1980). Sharing of a common resource is not sufficient to determine whether competition is

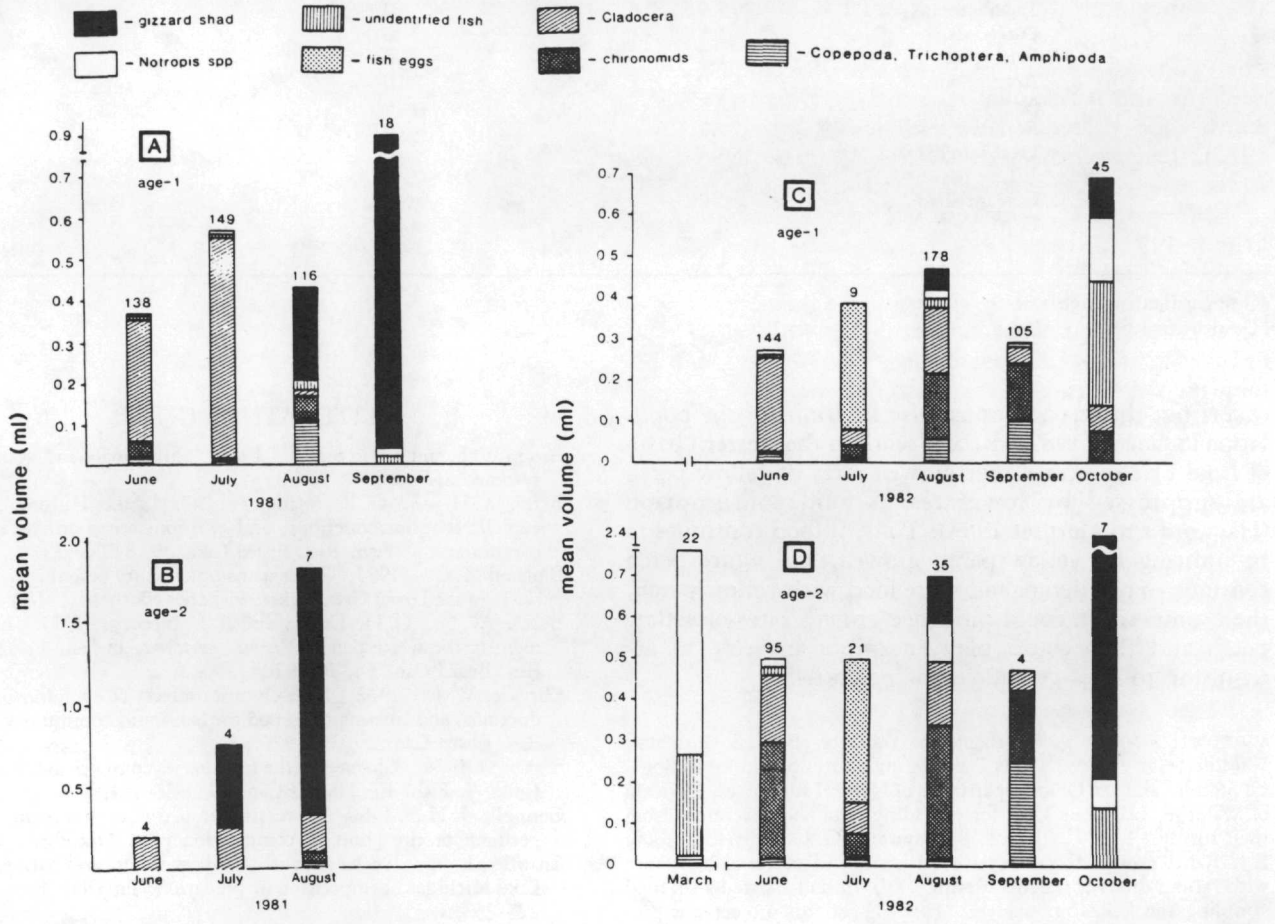

FIGURE 2. Food of white perch collected from Sandusky Bay and contiguous areas of Lake Erie: A — yearling fish collected in 1981; B — 2-year-old fish collected in 1981; C — yearling fish collected in 1982; D — 2-year-old fish collected in 1982. Sample sizes are shown at the tops of the bars.

TABLE 1

Mean percent volume (% vol) by food item of the diet, total number of stomachs containing food (N), and Schoener index of diet overlap for yellow perch (50- to 200-mm total length) and white perch (75- to 175-mm total length) collected from western Lake Erie, June-September 1981.

Month	Food item	Yellow perch % Vol	Yellow perch N	White perch % Vol	White perch N	Diet overlap
June	Cladocerans	72.0		87.2		
	Copepods	6.2		0		
	Chironomids	11.7		11.3		
	Amphipods	4.2		0		
	Pelecypods	1.1		0		
	Invertebrates[a]	4.0		0		
	Fish eggs	0		0.5		
	Fish[b]	0.8		1.0		
			25		138	0.62
July	Cladocerans	98.0		95.7		
	Copepods	1.0		0		
	Chironomids	0		3.1		
	Invertebrates[a]	1.0		0		
	Fish[b]	0		1.2		
			11		149	0.95
August	Cladocerans	13.1		9.7		
	Copepods	0		19.9		
	Chironomids	38.7		13.5		
	Notropis spp.	4.6		0		
	Gizzard shad	10.5		53.9		
	White perch	5.2		0		
	Fish[b]	27.9		3.0		
			22		116	0.45
September	Cladocerans	24.8		0		
	Copepods	0.4		8.5		
	Chironomids	17.8		0		
	Oligochaetes	3.7		0		
	Trichopterans	5.9		0		
	Ostracods	1.5		0		
	Pelecypods	11.7		0		
	Amphipods	5.0		0		
	Notropis spp.	12.7		0		
	Rainbow smelt	4.2		0		
	Freshwater drum	4.4		0		
	White bass	7.7		0		
	Gizzard shad	0.2		77.0		
	Fish[b]	0		14.5		
			24		18	0.01

[a]Unidentified invertebrates.
[b]Unidentified fish.

occurring; the resource must also be limiting the population (Schoener 1982). Recent work in the western basin of Lake Erie indicates that growth rates of yellow perch are suppressed by low rates of food consumption (Hayward and Margraf 1983). Thus, if food continues to be limiting for yellow perch growth, and white perch continue to proliferate and share food with yellow perch, then competition could influence growth rates of yellow perch and thus could play an important role in attempting to manage the yellow perch fishery.

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